PATENT SPECIFICATION 1,038,419

DRAWINGS ATTACHED.

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1,038,419

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Int. Cl.:—G 21.

COMPLETE SPECIFICATION.

Nuclear Reactor Power Stations.

We, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, London, a British Authority, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to nuclear reactor power stations.

It is known, in a pressurised gas-cooled nuclear reactor, to use steam generated from heat in the reactor coolant to power turbine-driven blowers for circulating the reactor coolant through the reactor. The exhaust steam from the turbines driving the blowers can be handled in two ways. It can either be condensed in the locality of the turbines (alternative 1) or it can be returned to the main electricity generating turbine steam circuit.

In the latter case it is possible to distinguish between two cases, one in which the steam for the blower turbines is taken from the high pressure line of the main steam cycle and returned at some intermediate pressure, such as into the cold re-heat line (alternative 2); and the other, in which the steam is taken at an intermediate pressure, for example, from a re-heat line, for driving the blower turbine, and then returned to the main turbine system at a relatively low pressure (alternative 3). Considering the three stated alternatives, alternative 1 suffers from the disadvantage of cost and inconvenience of a number of individual small condensers local to the positions occupied by the blowers in the reactor pressure vessel, and alternative 2, whilst it has some attractions, suffers from the disadvantage that it reduces the steam passing through the high pressure (H.P.) turbines in the main generating turbine set and reduces the power obtained from the main turbine set within a limitation set by low pressure (L.P) exhaust flow. It is a feature of gas-cooled reactor systems that the feed temperature required for optimum economic results is lower than that normally used in "conventional" (i.e. coal or oil-fired) stations. This already creates a flow of steam greater than desirable through the L.P. end of the main turbine set. Thus the use of H.P. steam for driving the blowers accentuates this and makes it less likely that standard designs of power generating turbines, as already developed for conventional stations, can be used without some modification.

Alternative 3 suffers from the disadvantage of taking large volumes of steam over long distances and incurring additional important pressure drops.

According to the present invention, a nuclear reactor power station having a steam powered system for circulating reactor coolant has the steam from the system exhausted to a desalination plant.

In one preferred form of the invention, the steam powered system receives steam at intermediate pressure, from a re-heat line, and exhausts at a pressure convenient for entry to a desalination plant, such as at about 2 atmospheres pressure.

The invention is particularly suitable for use with a reactor situated in a coastal locality with a need for supplementary fresh water supplies in the district.

In one arrangement, illustrated diagrammatically in Figure 1 of the accompanying drawings which is a flow diagram, a gas-cooled reactor of 1000 MW (electrical) generating capacity and provided in a coastal

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locality for electricity generation has steam generators heated by the reactor coolant gas, the steam produced being utilised in two 500 MW main electricity generating turbine sets in which the exhaust steam from the H.P. turbines returns for re-heat in the steam generators before passing to the intermediate pressure (I.P.) turbines and thence to the L.P. turbines and their condensers.

Four steam turbines (total 50 MW) powering the reactor coolant blowers are supplied with steam from the re-heat lines, two to each re-heat line as shown in the flow diagram. Exhaust steam from each pair of blower turbines is separately fed to a desalination plant, for sea-water evaporation purposes, before being returned to the appropriate boiler feed line, in the manner shown in the flow diagram. The efficiency of the blower turbines is reduced because of high exhaust pressure but this loss of efficiency is compensated by the desalination process providing fresh water to meet a demand in excess of that available from local sources and which would otherwise have to be met at greater cost by new plant reaching into remote fresh water sources.

In another construction, illustrated in Figure 2 of the drawings, which is also a flow diagram, the arrangement is as described with reference to Figure 1 except that, instead of the steam turbines which power the coolant blowers being fed with exhaust steam from the H.P. turbines of the main turbine sets, they are fed from exhaust steam from the I.P. turbines of the main sets, the I.P. turbines receiving steam from the re-heat lines. The remainder of this system is similar to that described with reference to Figure 1.

WHAT WE CLAIM IS:—

1. A nuclear reactor power station having a steam-powered system for circulating reactor coolant, characterised in that the steam from said system is exhausted to a desalination plant.

2. A nuclear reactor power station according to claim 1, wherein the said steam-powered system receives steam at an intermediate pressure from a re-heat line and exhausts at a pressure convenient for entry to a desalination plant, for example at about 2 atmospheres pressure.

3. A nuclear reactor power station having a steam system for power generation and for driving coolant circulator means, and incorporating desalination, substantially as hereinbefore described with reference to either one of the accompanying flow diagrams.

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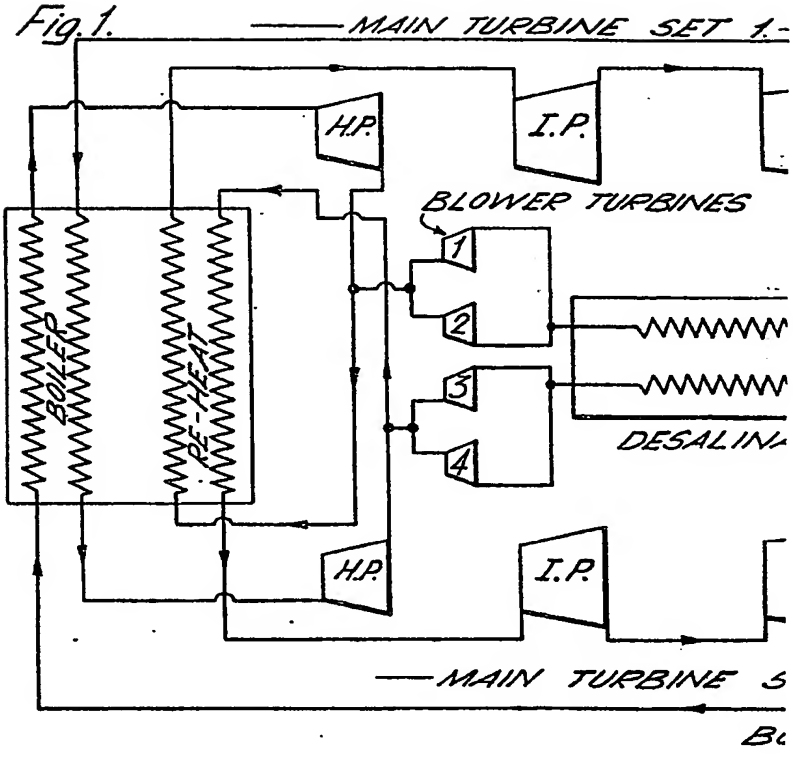
Fig. 1.


MAIN TURBINE SET 1
H.P.
I.P.
BLOWER TURBINES
1
2
3
4
BOILER
RE-HEAT
DESALIN
H.P.
I.P.
MAIN TURBINE S
B

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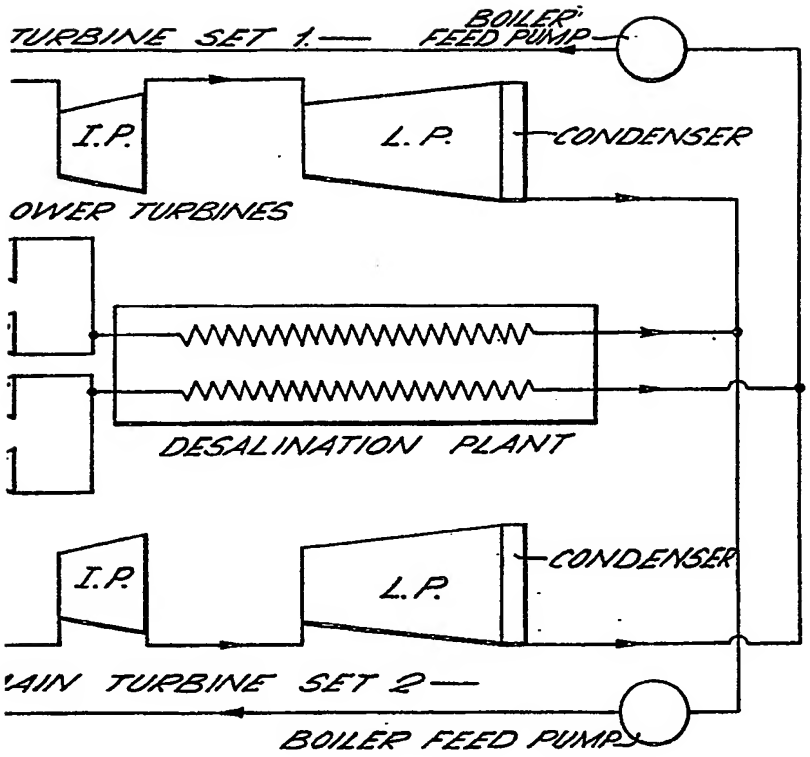
Sheet 1



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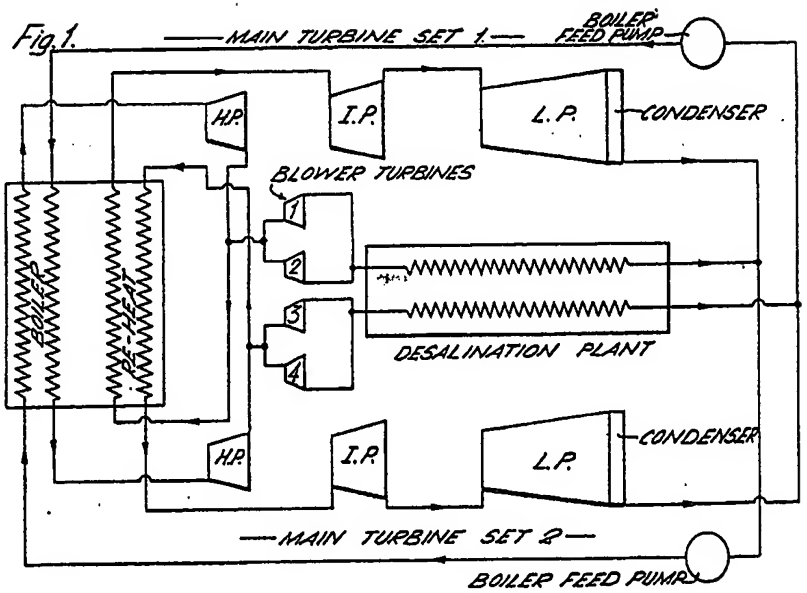
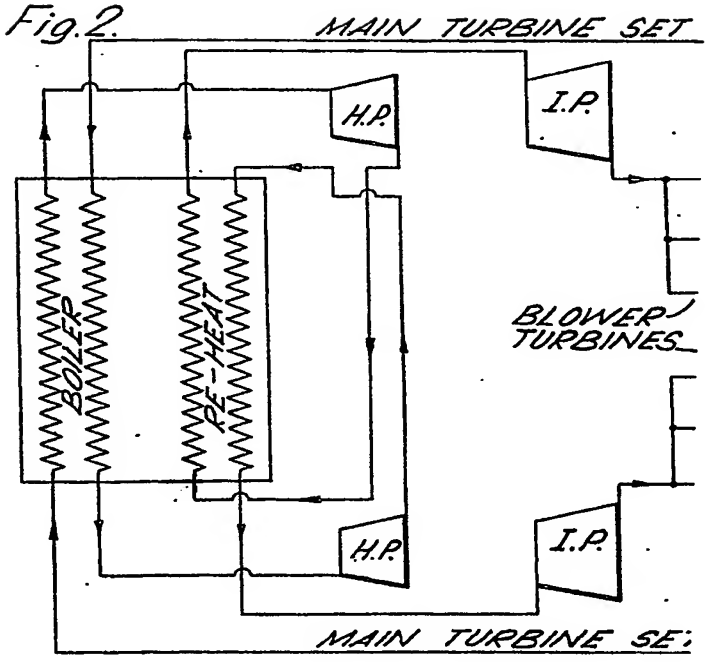


Fig. 2.


MAIN TURBINE SET
H.P.
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BOILER
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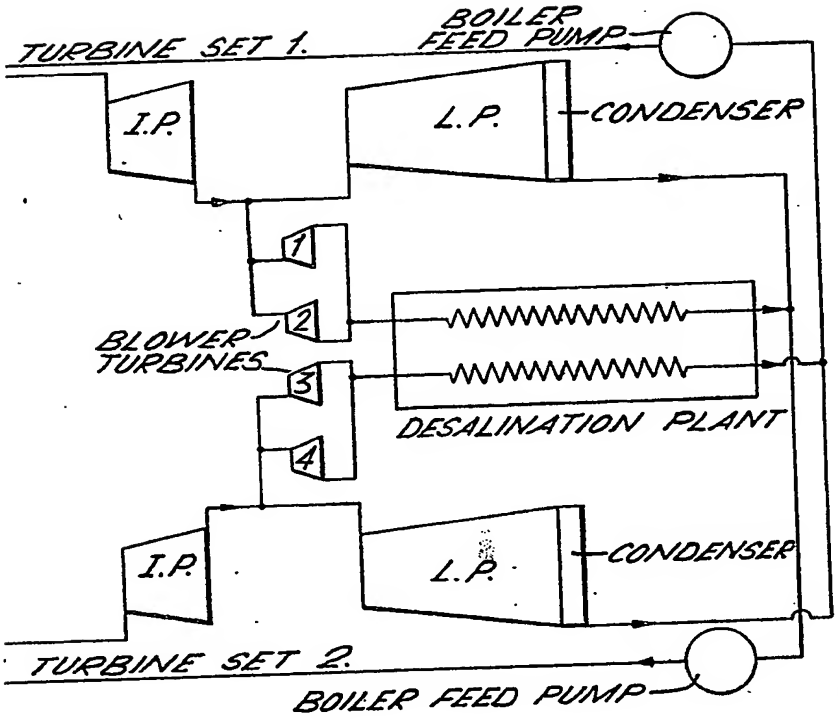
Sheet 2



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Sheet 2